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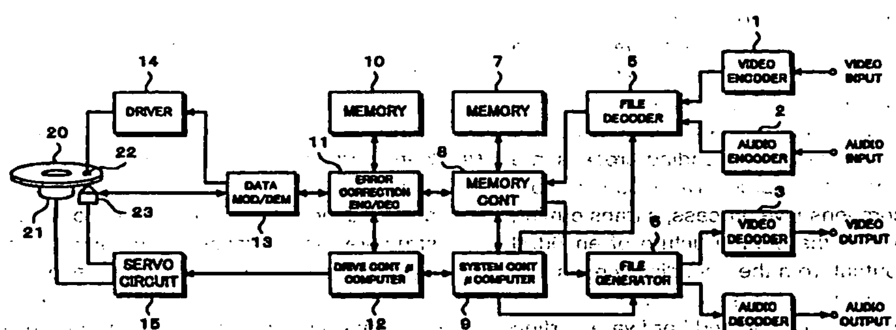
(54) Recording apparatus, recording method and record medium

(57) A recording apparatus for recording video data to a record medium is disclosed, that comprises an encoding means (1,2) for encoding video data in a group structure of a plurality of frames corresponding to a compression-encoding process in a combination of an inter-frame predictive encoding process and a motion compensative process, a transforming means (5) for transforming the data structure of encoded video data that is output from the encoding means (1,2) into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced, and a recording means (11,13,14) for recording data having the file structure to a record medium (20), wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and wherein at least one data structure is matched with the first data unit.

Fig. 1



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unit.

[0010] A fifth aspect of the present invention is a recording apparatus for recording video data and audio data to a rewritable optical disc, comprising a video encoding means for encoding video data in a group structure of a plurality of frames corresponding to a compression-encoding process in a combination of an inter-frame predictive encoding process and a motion compensative process, an audio output means for outputting compression-encoded or non-compressed audio data, a means for transforming the data structure of encoded video data that is output from the video encoding means and audio data that is output from the audio output means into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced and multiplexing the encoded video data and the audio data having the file structure, and a recording means for recording multiplexed data having the file structure to an optical disc, wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and wherein the second data unit is matched with a successive record length of which data is successively written to the optical disc.

[0011] A sixth aspect of the present invention is a recording method for recording video data to a record medium, comprising the steps of encoding video data in a group structure of a plurality of frames corresponding to a compression-encoding process in a combination of an inter-frame predictive encoding process and a motion compensative process, transforming the data structure of encoded video data into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced, and recording data having the file structure to a record medium, wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and wherein at least one data structure is matched with the first data unit.

[0012] A seventh aspect of the present invention is a recording method for recording video data to a rewritable optical disc, comprising the steps of encoding video data corresponding to a compression-encoding process, transforming the data structure of encoded video data into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced, and recording data having the file structure to an optical disc, wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and wherein the second data unit is matched with a successive record length of data written to the optical disc.

[0013] An eighth aspect of the present invention is a recording method for recording audio data to a rewritable optical disc, comprising the steps of transforming the data structure of audio data or encoded audio data into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced, and recording data having the file structure to the optical disc, wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and wherein the second data unit is matched with a successive record length of data written to the optical disc.

[0014] A ninth aspect of the present invention is a recording method for recording video data and audio data to a record medium, comprising the steps of encoding video data in a group structure of a plurality of frames corresponding to a compression-encoding process in a combination of an inter-frame predictive encoding process and a motion compensative process, outputting compression-encoded or non-compressed audio data, transforming the data structure of encoded video data and audio data into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced and multiplexing the encoded video data and the audio data having the file structure, and recording multiplexed data having the file structure to a record medium, wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and wherein at least one data structure of the encoded video data is matched with the first data unit.

[0015] A tenth aspect of the present invention is a recording method for recording video data and audio data to a rewritable optical disc, comprising the steps of encoding video data in a group structure of a plurality of frames corresponding to a compression-encoding process in a combination of an inter-frame predictive encoding process and a motion compensative process, outputting compression-encoded or non-compressed audio data, transforming the data structure of encoded video data and audio data into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced and multiplexing the encoded video data and the audio data having the file structure, and recording multiplexed data having the file structure to an optical disc, wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and wherein the second data unit is matched with a successive record length of which data is successively written to the optical disc.

[0016] An eleventh aspect of the present invention is a record medium on which a program for recording video data to a record medium has been recorded, the program causing a computer to perform the steps of encoding video data in a group structure of a plurality of frames corresponding to a compression-encoding process in a combination of art inter-frame predictive encod-

encoded audio and a QuickTime file format according to an example embodiment of the present invention;

Figs. 5A and 5B are schematic diagrams for explaining another example of the relation between a compression-encoded audio and a QuickTime file format according to an example embodiment of the present invention;

Figs. 6A, 6B, 6C, and 6D are schematic diagrams for explaining the relation between GOPs of an MPEG video and a QuickTime file format according to an example embodiment of the present invention;

Figs. 7A, 7B, 7C, and 7D are schematic diagrams for explaining an example of the relation between a compression-encoded audio and a QuickTime file format according to an example embodiment of the present invention;

Fig. 8 is a schematic diagram for explaining an example of a recording method for an optical disc according to an example embodiment of the present invention; and

Fig. 9 is a schematic diagram for explaining another example of a recording method for an optical disc according to an example embodiment of the present invention.

[0024] Next, with reference to the accompanying drawings, an example embodiment of the present invention will be described. Fig. 1 shows an example of the structure of a digital recording and reproducing apparatus according to an example embodiment of the present invention. An input video signal is supplied to a video encoder 1 shown in Fig. 1. The video encoder 1 compression-encodes the video signal. In addition, an input audio signal is supplied to an audio encoder 2. The audio encoder 2 compression-encodes the audio signal. The compression-encoding method applied for the video signal and the audio signal is for example MPEG. Output signals of the video encoder 1 and the audio encoder 2 are referred to as elementary streams.

[0025] When MPEG is used, the video encoder 1 is composed of a motion predicting portion, a picture sequence rearranging portion, a subtracting portion, a DCT portion, a quantizing portion, a variable length code encoding portion, and a buffer memory. The motion predicting portion detects a moving vector. The subtracting portion forms a predictive error between an input picture signal and a locally decoded picture signal. The DCT portion transforms an output signal of the subtracting portion corresponding to the DCT method. The quantizing portion quantizes an output signal of the DCT portion. The variable length encoding portion encodes an output signal of the quantizing portion into a signal having a variable length. The buffer memory outputs the encoded data at a constant data rate. The picture sequence rearranging portion rearranges the sequence of pictures corresponding to the encoding process. In other words, the picture sequence rearranging portion rearranges the sequence of pictures so that after I and P pictures are encoded, a B picture is encoded. The local decoding portion is composed of an inverse quantizing portion, an inverse DCT portion, an adding portion, a frame memory, and a motion compensating portion. The motion compensating portion performs all of a forward predicting operation, a reverse predicting operation, and a bidirectional predicting operation. When the intra encoding process is performed, the subtracting portion directly passes data, not performs the subtracting process. The audio encoder 2 comprises a sub-band encoding portion and an adaptively quantized bit allocating portion.

[0026] As an example, in the case of a portable disc recording and reproducing apparatus with a built-in camera, a picture photographed by the camera is input as video data. In addition, a voice collected by a microphone is input as audio data. The video encoder 1 and the audio encoder 2 convert analog signals into digital signals. According to the embodiment of the present invention, a rewritable optical disc is used as a record medium. Examples of such an optical disc are a magneto-optical disc and a phase-change type disc. According to the embodiment of the present invention, a magneto-optical disc having a relatively small diameter is used.

[0027] Output signals of the video encoder 1 and the audio encoder 2 are supplied to a file generator 5. The file generator 5 converts output signals of the video encoder 1 and the audio encoder 2 into a video elementary stream and an audio elementary stream so that they can be handled corresponding to a computer software program for synchronously reproducing a moving picture and a sound without need to use a dedicated hardware portion. According to the embodiment of the present invention, for example, as such a software program, QuickTime is used. A sequence of data (video data, audio data, and text data) that varies on time base and that is process by QuickTime is referred to as QuickTime movie. The file generator 5 multiplexes encoded video data and encoded audio data. To generate a QuickTime movie file, a system controlling microcomputer 9 controls the file generator 5.

[0028] QuickTime movie files generated by the file generator 5 are successively written to a memory 7 through a memory controller 8. When the system controlling microcomputer 9 issues a data write request for a disc to the memory controller 8, the memory controller 8 reads a QuickTime movie file from the memory 7. In this example, the transfer rate of the encoding process for a QuickTime movie file is lower than that for data written to the disc. For example, the former is half of the latter. Thus, although QuickTime movie files are successively written to the memory 7, they are intermittently read from the memory 7 under the control of the system controlling microcomputer 9 in such a manner that the memory 7 is prevented from overflowing or underflow-

synchronously output from the file decoder 6.

[0039] The video decoder 3 and the audio decoder 4 compression-decode the video elementary stream and the audio elementary stream and generate a video output signal and an audio output signal, respectively. In this example, the video signal and the audio signal have been encoded corresponding to MPEG. A video output signal is output to a display (liquid crystal display or the like) through a display driver and displayed as a picture. Likewise, an audio output signal is output to a speaker through an audio amplifier and reproduced as a sound (these structural portions are not shown).

[0040] The video decoder 3 is composed of a buffer memory, a variable length code decoding portion, an inverse DCT portion, an inverse quantizing portion, an adding portion, and a local decoding portion. The adding portion adds an output signal of the inverse quantizing portion and a local decoded output signal. The local decoding portion is composed of a picture sequence rearranging portion, a frame memory, and a motion compensating portion. When an intra encoding process is performed, the adding portion directly passes data, not performs the adding process. Decoded data is output from the adding portion to the picture sequence rearranging portion. The picture sequence rearranging portion rearranges the decoded pictures in the original order.

[0041] As was described above, since the optical disc 20 on which data is recorded is attachable and detachable, the data recorded on the optical disc 20 can be reproduced by another apparatus. For example, a personal computer that operates with QuickTime application software may read data recorded on the optical disc 20 and reproduce video data and audio data therefrom. It should be noted that the present invention can be applied to an apparatus that handles only video data or only audio data.

[0042] Next, an example embodiment of the present invention will be described in more detail. First of all, with reference to Fig. 2, QuickTime will be described in brief. QuickTime is an OS expansion function for reproducing a moving picture without need to use dedicated hardware. There are various data formats for QuickTime. In other words, audio data, video data, MDI, and so forth of up to 32 tracks can be synchronously output.

[0043] A QuickTime movie file is roughly divided into two major portions that are a movie resource portion and a movie data portion. The movie resource portion contains time data necessary for reproducing the QuickTime movie file and information necessary for referencing real data. The movie data portion contains real data of video data and real data of audio data.

[0044] One QuickTime movie file can contain different types of medium data such as a sound, a video, and a text as independent tracks that are a sound track, a video track, and a text track, respectively. These independent tracks are strictly controlled on time base. Each track has a medium for referencing the compression method of the real data and the display time period thereof. The medium contains the minimum sample size of the real data in the movie data portion, the position of a chunk that is a block of a plurality of samples, and the display duration of each sample.

[0045] Fig. 2 shows an example of a QuickTime file that handles audio data and video data. The largest structural portions of the QuickTime file are a movie resource portion and a movie data portion. The movie resource portion contains the duration necessary for reproducing the file and data necessary for referencing the real data. The movie data portion contains real data of video data, audio data, and so forth.

[0046] Next, the movie resource portion will be described in detail. The movie resource portion contains a movie header 41 and tracks. The movie header 41 contains general file information. There are a plurality of tracks corresponding to the number of types of data. Fig. 2 shows an example of the internal structure of a video track 50 in detail. The video track 50 contains a track header 42 and a medium portion. The track header 42 contains general track information. The medium portion contains a medium header 43, a medium handler 44, and a medium information portion. The medium header 43 contains general medium information. The medium handler 44 contains medium data handling information.

[0047] The medium information portion contains a medium handler 45, a data handler 46, data information 47, and a sample table. The medium handler 45 contains picture medium information. The data handler 46 contains picture data handling information. The data information 47 contains data information. The sample table contains a sample description, a time-to-sample, a sample size 48, a sample-to-chunk, a chunk offset 49, a sync sample, and so forth. The sample description contains each sample. The time-to-sample represents the relation between a sample and the time base. The sample size 48 represents the size of the sample. The sample-to-chunk represents the relation between the sample and the chunk. The chunk offset 49 represents the start byte position of the chunk in the movie file. The sync sample contains synchronous information. Likewise, an audio track 51 has a structure (not shown) similar to that of a video track.

[0048] On the other hand, the movie data portion contains audio data encoded corresponding to for example MPEG Audio Layer 2 and picture data encoded in the compression-encoding method corresponding to for example MPEG (Moving Picture Expert Group) method in the unit of chunks each of which is composed of a predetermined number of samples. However, it should be noted that the present invention is not limited to such an encoding method. In addition, the moving data portion may contain linear data that has not been compression-encoded.

[0049] Each track of the movie resource portion is

ning of each GOP. The sequence header and one GOP compose one video decoding unit. Since a sequence header is placed to each GOP, each sample can be directly edited and decoded with QuickTime. The video encoder 1 shown in Fig. 1 outputs an MPEG video elementary stream shown in Fig. 3A.

[0057] As shown in Fig. 3B, one video decoding unit is treated as one sample of the QuickTime file format. Six chronologically successive samples (for example, sample #0 to sample #5) are treated as one video chunk (for example, chunk #0). The duration of one chuck is 3 seconds. Alternatively, six GOPs may be treated as one video chunk so that one chuck corresponds to one sample. In this case, the duration of one chuck is 3 seconds.

[0058] Figs. 4A and 4B show the relation among audio frames encoded corresponding to MPEG audio layer 2, GOPs, and units of samples and chunks in the QuickTime file format. In layer 2, 1152 audio samples/channel are treated as one audio frame. As shown in Fig. 4A, in stereo, 1152 audio samples x 2 channels are encoded in layer 2 and treated as one audio decoding unit. One audio decoding unit contains data of 384 bytes x 2 channels that have been compression-encoded. The audio decoding unit contains a header and information necessary for decoding the encoded data (allocation, scale factor, and so forth).

[0059] As shown in Fig. 4B, one audio decoding unit is treated as one sample of the QuickTime file format. Thus, each audio sample can be decoded with QuickTime. 125 chronological successive samples (for example, sample #0 to sample #124) are treated as one audio chunk (for example, chuck #0). The duration of one chuck is 3 seconds in the case that the audio sampling frequency is 48 kHz.

[0060] In Figs. 3A, 3B, 4A, and 4B, a video data file and an audio data file are separately shown. The file generator 5 multiplexes a video data file and an audio data file as one data stream and thereby generates a QuickTime movie file. In the QuickTime movie file, video chunks and audio chucks are alternatively placed on time base. In this case, video chunks and audio chunks are placed in such a manner that a video chuck adjacents to an audio chunk corresponding thereto. As was described above, the duration of video data of one video chunk is equal to the duration of audio data of one audio chunk (for example, 3 seconds).

[0061] As another example of the audio compression-encoding method, ATRAC (Adaptive Transform Acoustic Coding) used for Mini Disc may be used. In ATRAC, audio data of 16 bits sampled at 44.1 kHz is processed. The minimum data unit processed in ATRACK is one sound unit. In stereo, one sound unit is composed of 512 samples x 16 bits x 2 channels.

[0062] When ATRACK is used as an audio compression-encoding method, as shown in Fig. 5A, one sound unit is compressed to an audio decoding unit of 212 bytes x 2 channels. As shown in Fig. 5B, one audio decoding unit is treated as one sample in the QuickTime file format. 64 samples are treated as one chunk in the QuickTime file format.

[0063] According to at least preferred embodiments of the present invention, the audio data may be recorded on a non-compression basis. The non-compression method is referred to as linear PCM. Likewise, in linear PCM, 512 audio samples are treated as one audio decoding unit. One audio decoding unit is treated as one sample in the QuickTime file format.

[0064] Figs. 6A, 6B, 6C, and 6D show a QuickTime file format for video data in the case that video data and audio data are multiplexed. As shown in Fig. 6A, the period of a video frame is t0 seconds and the number of frames of one GOP is f0. When original video data is encoded corresponding to MPEG2, an MPEG video elementary stream shown in Fig. 6B is formed. As was described above, a sequence header (SH) is placed to each GOP.

[0065] As shown in Fig. 6C, one GOP with a sequence header is treated as one sample in the QuickTime file format. The length of one sample is referred to as sample size. With a plurality of samples (for example, six samples), one chunk is composed in the QuickTime file format. As shown in Fig. 6D, video chunks and audio chunks are alternately placed on time base and thereby multiplexed. As a result, a QuickTime movie file is formed. The beginning of each video chunk of the QuickTime movie file is referred to as video chunk offset. The video chunk offset is represented by the number of bytes from the beginning of the file to the beginning of the video chunk.

[0066] Figs. 7A, 7B, 7C, and 7D show a QuickTime file format of audio data in the case that video data and audio data are multiplexed. As shown in Fig. 7A, an original audio signal is digitized. One audio frame contains f0 audio samples x n channels. When the original audio data is compression-encoded corresponding to MPEG audio, an MPEG audio elementary stream shown in Fig. 7B is formed.

[0067] As shown in Fig. 7C, for example one audio decoding unit is treated as one sample of the QuickTime file format. The size of one sample is referred to as sample size. A plurality of samples (for example, 125 samples) composes one chunk of the QuickTime file format. As shown in Fig. 7D, video chunks and audio chunks are alternately placed and thereby multiplexed. As a result, a QuickTime movie file is formed. The beginning of each audio chunk of a QuickTime movie file is referred to as audio chunk offset. The audio chunk offset is represented by the number of bytes from the beginning of the file to the beginning of the audio chunk. The duration of each video chunk is the same as the duration of each audio chunk. For example, the duration is 3 seconds.

[0068] The sample size of a video sample, the sample size of an audio sample, the offset value of a video chunk, and the offset value of an audio chunk are contained in the resource of a QuickTime movie file. With

encoding means for encoding video data corresponding to a compression-encoding process;
transforming means for transforming the data structure of encoded video data that is output from said encoding means into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced; and
recording means for recording data having the file structure to an optical disc,
wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and
wherein the second data unit is matched with a successive record length of data written to the optical disc.

3. The recording apparatus as set forth in claim 1, wherein the compression-encoding process is MPEG,
wherein the group structure is GOP structure, and
wherein data of which a sequence header is added to each GOP is matched with the first data unit.

4. A recording apparatus for recording audio data to a rewritable optical disc, comprising:

transforming means for transforming the data structure of audio data or encoded audio data into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced; and
recording means for recording data having the file structure to the optical disc,
wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and
wherein the second data unit is matched with a successive record length of data written to the optical disc.

5. A recording apparatus for recording video data and audio data to a record medium, comprising:

video encoding means for encoding video data in a group structure of a plurality of frames corresponding to a compression-encoding process in a combination of an inter-frame predictive encoding process and a motion compensative process;
audio output means for outputting compression-encoded or non-compressed audio data;
means for transforming the data structure of encoded video data that is output from said video encoding means and audio data that is output from said audio output means into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced and multiplexing the encoded video data and the audio data having the file structure; and
recording means for recording multiplexed data having the file structure to a record medium,
wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and
wherein at least one data structure of the encoded video data is matched with the first data unit.

6. A recording apparatus for recording video data and audio data to a rewritable optical disc, comprising:

video encoding means for encoding video data in a group structure of a plurality of frames corresponding to a compression-encoding process in a combination of an inter-frame predictive encoding process and a motion compensative process;
audio output means for outputting compression-encoded or non-compressed audio data;
means for transforming the data structure of encoded video data that is output from said video encoding means and audio data that is output from said audio output means into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced and multiplexing the encoded video data and the audio data having the file structure; and
recording means for recording multiplexed data having the file structure to an optical disc,
wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and
wherein the second data unit is matched with a successive record length of which data is successively written to the optical disc.

7. The recording apparatus as set forth in claim 5 or 6, wherein the duration of the encoded video data of the second data unit is the same as the duration of the encoded audio data of the second data unit in the multiplexed data.

8. The recording apparatus as set forth in claim 5 or 6, wherein the encoded video data of the second data unit and the encoded audio data of the second data unit are alternately placed in the multiplexed data, each of the encoded video data of the second data unit and the encoded audio data of the

plurality of frames corresponding to a compression-encoding process in a combination of an inter-frame predictive encoding process and a motion compensative process;
outputting compression-encoded or non-compressed audio data;
transforming the data structure of encoded video data and audio data into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced and multiplexing the encoded video data and the audio data having the file structure; and
recording multiplexed data having the file structure to an optical disc,
wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and
wherein the second data unit is matched with a successive record length of which data is successively written to the optical disc.

17. A record medium on which a program for recording video data to a record medium has been recorded, the program causing a computer to perform the steps of:

encoding video data in a group structure of a plurality of frames corresponding to a compression-encoding process in a combination of an inter-frame predictive encoding process and a motion compensative process;
transforming the data structure of encoded video data into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced; and
recording data having the file structure to a record medium,
wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and
wherein at least one data structure is matched with the first data unit.

18. A record medium on which a program for recording video data to a rewritable optical disc has been recorded, the program causing a computer to perform the steps of:

encoding video data corresponding to a compression-encoding process;
transforming the data structure of encoded video data into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced; and
recording data having the file structure to an optical disc,
wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and
wherein the second data unit is matched with a successive record length of data written to the optical disc.

19. A record medium on which a program for recording audio data to a rewritable optical disc has been recorded, the program causing a computer to perform the steps of:

transforming the data structure of audio data or encoded audio data into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced; and
recording data having the file structure to the optical disc,
wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and
wherein the second data unit is matched with a successive record length of data written to the optical disc.

20. A record medium on which a program for recording video data and audio data to a record medium has been recorded, the program causing a computer to perform the steps of:

encoding video data in a group structure of a plurality of frames corresponding to a compression-encoding process in a combination of an inter-frame predictive encoding process and a motion compensative process;
outputting compression-encoded or non-compressed audio data;
transforming the data structure of encoded video data and audio data into a file structure that can be processed by a computer software program without a dedicated hardware portion so that moving pictures and so forth are synchronously reproduced and multiplexing the encoded video data and the audio data having the file structure; and
recording multiplexed data having the file structure to a record medium,
wherein the file structure has a first data unit and a second data unit, the second data unit being a set of the first data units, and
wherein at least one data structure of the encoded video data is matched with the first

Fig. 1

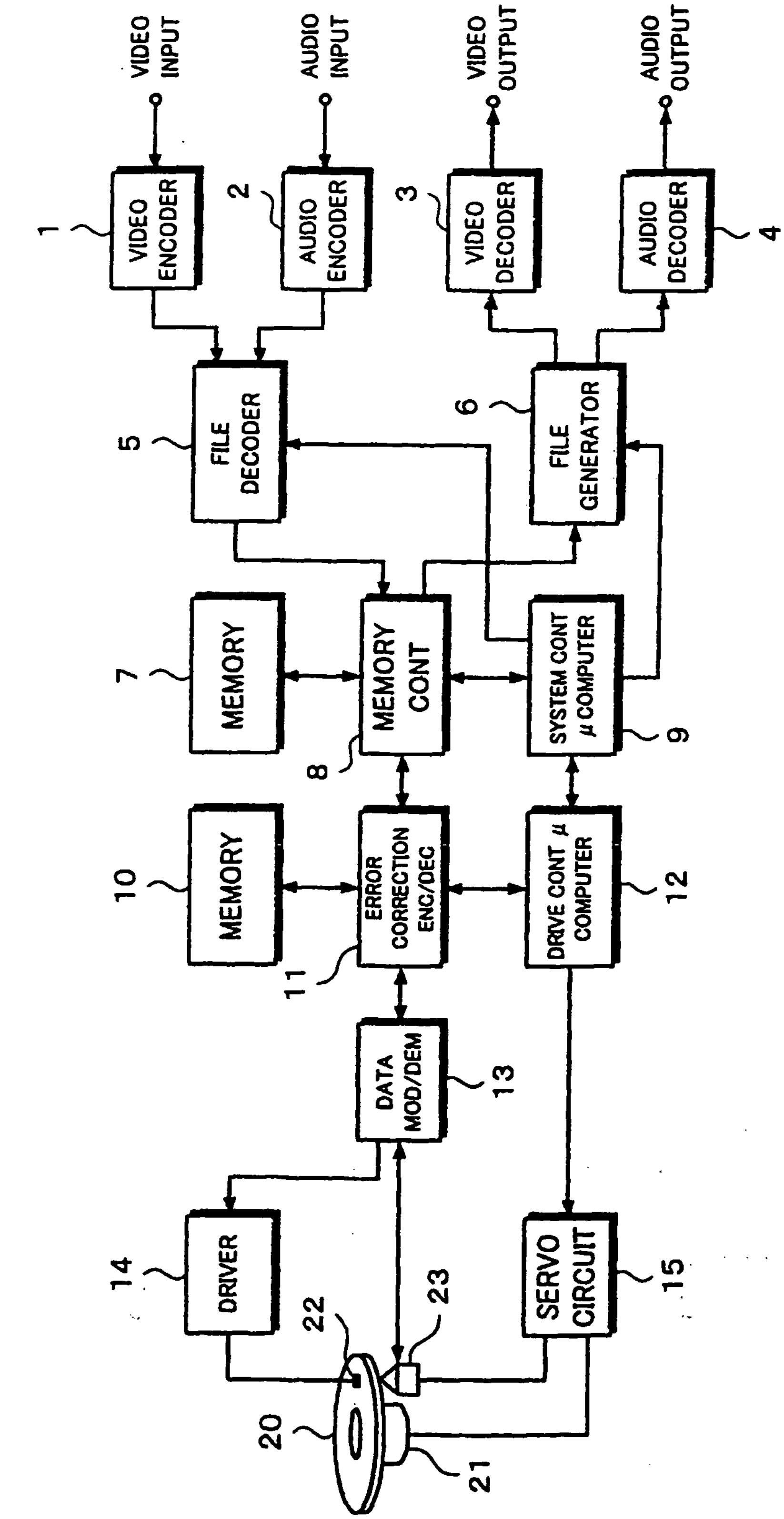
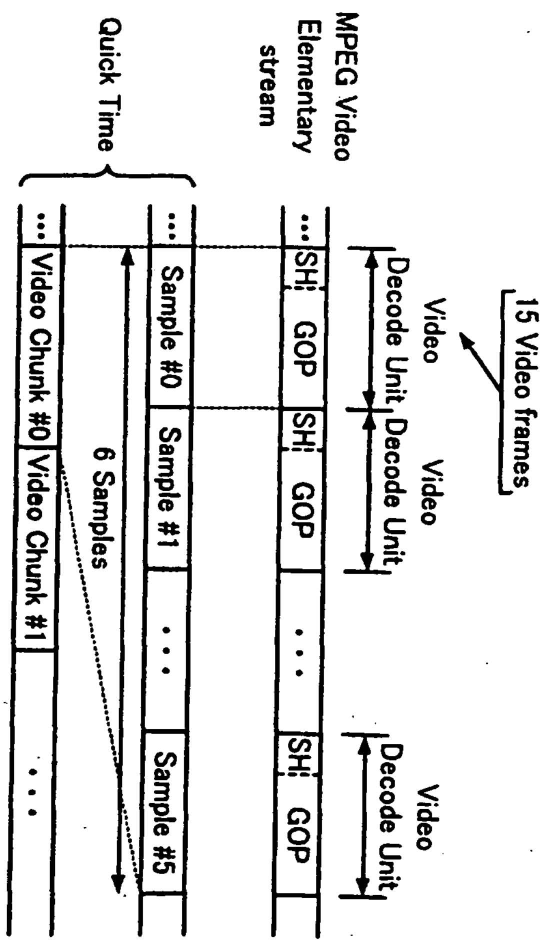

VIDEO INPUT
AUDIO INPUT
VIDEO OUTPUT
AUDIO OUTPUT
1
VIDEO ENCODER
2
AUDIO ENCODER
3
VIDEO DECODER
4
AUDIO DECODER
5
FILE DECODER
6
FILE GENERATOR
7
MEMORY
8
MEMORY CONT
9
SYSTEM CONT μ COMPUTER
10
MEMORY
11
ERROR CORRECTION ENC/DEC
12
DRIVE CONT μ COMPUTER
13
DATA MOD/DEM
14
DRIVER
15
SERVO CIRCUIT
20
21
22
23

Fig. 3A

Fig. 3B



15 Video frames
Video Decode Unit
Video Decode Unit
Video Decode Unit
MPEG Video Elementary stream
SH GOP
SH GOP
SH GOP
Sample #0
Sample #1
Sample #5
6 Samples
Quick Time
Video Chunk #0
Video Chunk #1

Fig. 5A

Fig. 5B

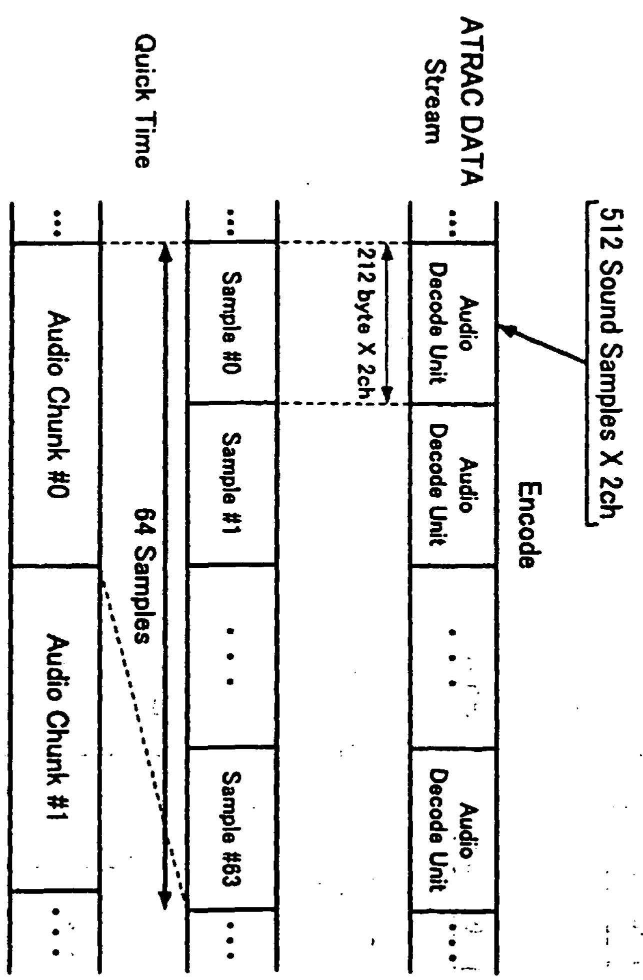

512 Sound Samples X 2ch
Encode
ATRAC DATA Stream
Audio Decode Unit
Audio Decode Unit
Audio Decode Unit
212 byte X 2ch
Sample #0
Sample #1
Sample #63
64 Samples
Quick Time
Audio Chunk #0
Audio Chunk #1

Fig. 7D

Fig. 7C

Fig. 7B

Fig. 7A

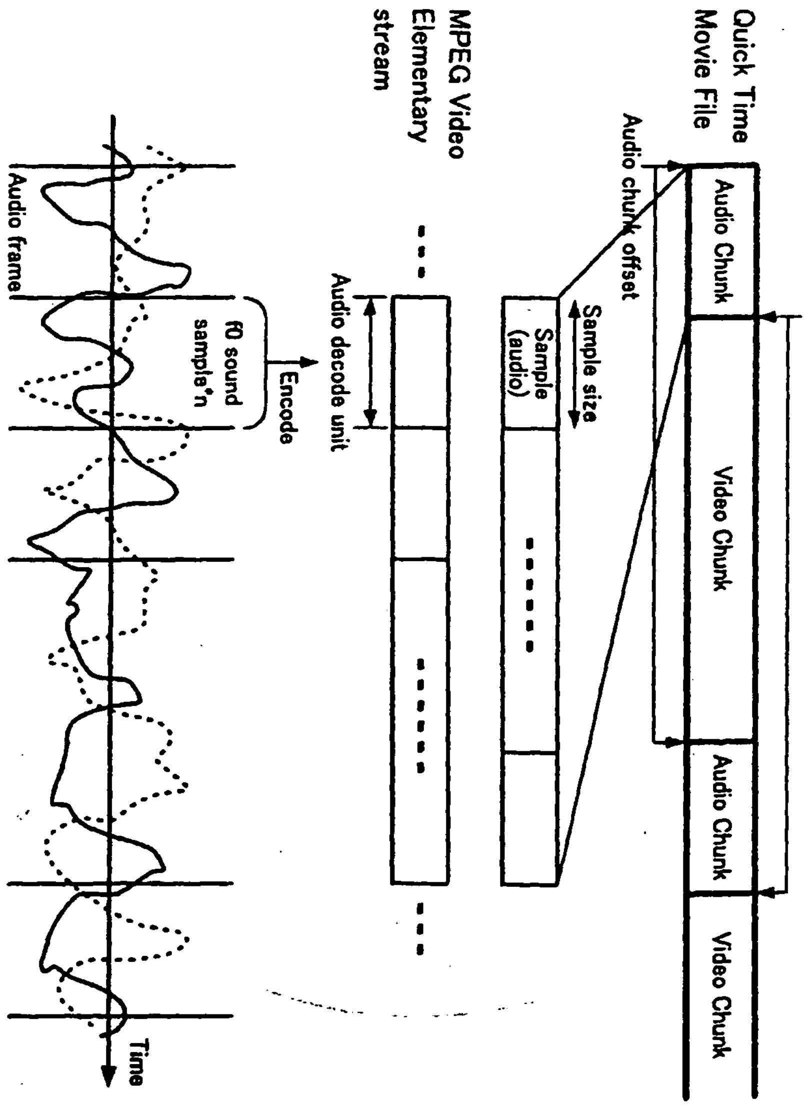
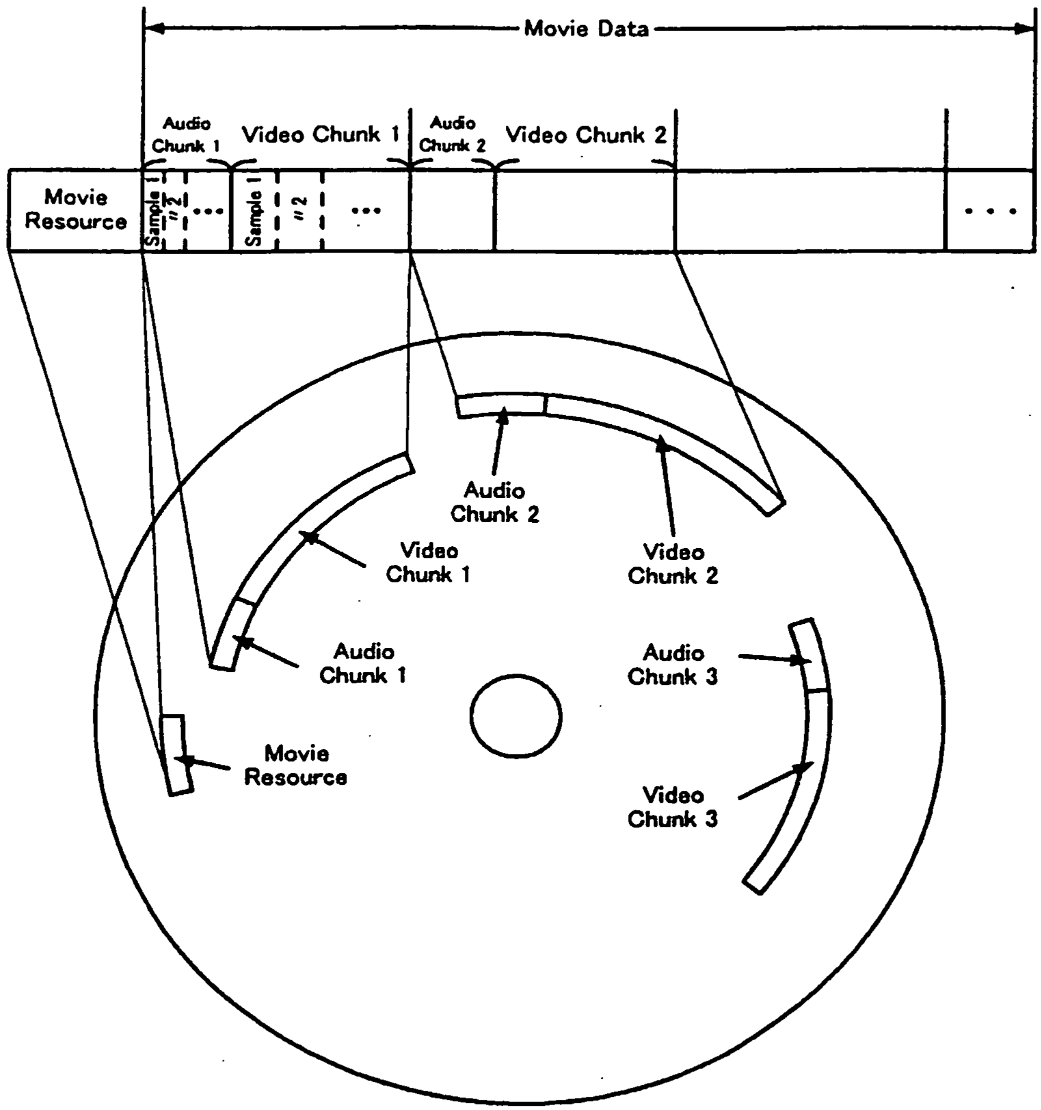


Fig. 9


Movie Data
Audio Chunk 1
Video Chunk 1
Audio Chunk 2
Video Chunk 2
Movie Resource
Sample 1
2
Sample 1
2
Audio Chunk 2
Video Chunk 1
Video Chunk 2
Audio Chunk 1
Audio Chunk 3
Movie Resource
Video Chunk 3